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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1142

RESEARCH, DEVELOPMENT AND TESTS OF HIGH PERFORMANCE AIRCRAFT MACHINE GUN FUZES

22nd Partial Report

TESTS OF OERLIKON BZ AND KZ FUZES FOR 20MM AMMUNITION

FINAL Report

Task Assignment NPG-Re2b-327-1-53

Copy No. ___

Classification CONFIDENTIAL SECURITY INFORMATION

Tests of Oerlikon BZ and KZ Fuzes for 20mm Ammunition

PART A

SYNOPSIS

1. This test was conducted to determine: the functioning performance and/or sensitivity of the Oerlikon KZ and BZ fuzes against various targets at various obliquities, the approximate delay of fuze action, the distance from the muzzle where the fuzes armed, and the time and range of self-destruction.

2. It is concluded from the results obtained that:

a. The KZ and BZ fuzes gave no bore or flight premature detonations when fired as single rounds from the Oerlikon 5TG gun.

b. The BZ base fuze assembled in the PS/B armor piercing explosive projectile when fired with mean velocities of 3254 to 3315 ft/sec:

(1) Was unstable in flight and fuze functioning was not determinable.

(2) Gave a slightly better functioning performance but yawed slightly more with projectiles known to have lead in the cavity. (Based upon limited comparative firings of projectiles with and without lead in the cavity.)

(3) Exhibited a 92% self-destruction performance at an average range of 2287.4 yards from the muzzle with an average flight time of 4.60 seconds.

(4) Detonated with delayed fuze action of approximately .001 second when fired against a 0".125 mild steel target.

c. The KZ nose fuze assembled in the SS/K explosive projectile when fired with mean velocities of 3619 to 3731 ft/sec:

(1) Functioned 100% versus 0".125 24S-T3 aluminum alloy and all heavier targets employed at 0° obliquity.

(2) Functioned 100% against 0".020 24S-T3 aluminum alloy at 30° obliquity and against 0".125 24S-T3 aluminum alloy at 80° obliquity.

(3) Gave a functioning performance of 80% or greater against: 0".020 24S-T3 aluminum alloy at obliquities of 0° to 70°, 0".125 24S-T3 aluminum alloy at obliquities of 0° to 80°, and versus 0".190 Beaverboard, 0".040 24S-T3 aluminum alloy, and 0".016 24S-T3 clad aluminum alloy at 0° obliquity.

(4) Was sensitive enough to function 40% on 0".020 Blotter paper at 0° obliquity.

(5) Was not armed at 50 feet from the muzzle, but was fully armed at a distance of 500 feet from the muzzle when fired against a target of 0".125 mild steel.

(6) Exhibited an 88% self-destruction performance at an average range of 2842.3 yards with an average flight time of 5.47 seconds.

(7) Detonated with delayed fuze action of approximately .00015 second when fired against thin targets of 0".016 to 0".040 24S-T3 aluminum alloy at 0° obliquity.

Tests of Oerlikon BZ and KZ Fuzes for 20mm Ammunition

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PART B

INTRODUCTION

1. AUTHORITY:

The subject test was conducted under reference (a), Task Assignment NPG-Re2b-327-1-53, as authorized by reference (b), and in accordance with references (c), (d), (e), and (f).

2. REFERENCES:

(a) BUORD Conf ltr Re2b-DBLaP:bjn NP9 Ser 42738 of 29 July 1952
(b) NOL Conf ltr TF:DEL:hcw NP/NOL/X1-1 (3026) Ser 01725 of 6 August 1952
(c) NOL Conf Work Request 8195A of 5 September 1952
(d) NOL Rest Work Request 8195C of 1 December 1952
(e) NOL Conf Work Request 8195C of 23 March 1953
(f) NOL Conf Work Request 8195D of 20 April 1953

3. BACKGROUND:

The Naval Ordnance Laboratory requested the Naval Proving Ground by reference (b) to assist in the evaluation of two (2) new types of 20mm fuzes manufactured by the Oerlikon Machine Tool Works, Buehrle and Company, Zurich-Oerlikon, Switzerland. Type KZ is a nose fuze with mechanical self-destruction and a prolonged muzzle safety feature. Type BZ is a base fuze with a mechanical self-destruction feature. The KZ fuze is assembled in a high explosive projectile and the BZ fuze is assembled in a semi-armor piercing projectile. This report covers the tests as requested in paragraphs A2, B1, and B2 of reference (c), paragraphs 1 and 2 of reference (d), paragraphs 1 and 2 of reference (e), and paragraphs 1 and 2 of reference (f).

4. OBJECT OF TEST:

These tests were conducted to determine: the functioning performance and/or sensitivity of the KZ and BZ Oerlikon fuzes against various targets at various obliquities, the approximate delay of fuze action, the distance from the muzzle where the fuzes armed, and the time and range of self-destruction.

5. PERIOD OF TEST:

a.	Date of Authorizing letter	6 August 1952
b.	Dates Material Received	1 March 1951 to 6 April 1953
c.	Date Commenced Test	19 September 1952
d.	Date Test Completed	11 May 1953

6. REPRESENTATIVES PRESENT:

One (1) or more of the following representatives were present to witness portions of the ballistic tests reported herein:

Mr. D. E. Lord	Naval Ordnance Laboratory
Mr. R. A. Buck	Naval Ordnance Laboratory
Mr. C. A. Browning	Naval Ordnance Laboratory
Mr. M. V. M. Korty	Naval Ordnance Laboratory
Mr. P. B. Morgan	Naval Ordnance Laboratory
Mr. E. L. Morgan	Naval Ordnance Laboratory
Mr. R. H. Suessle	Naval Ordnance Laboratory

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

The Oerlikon 20mm fuzes, types KZ and BZ, are described in detail in Oerlikon Machine Tool Works Brochures 932, 950, 1012, 1053, 1054, 1099, and 1143. The KZ nose fuze and BZ base fuze have direct action firing pins restrained by safety bolts and are armed by set back and spin. The self destruction feature of both types depends upon decreased spin with range for operation. The type KZ nose fuze has a prolonged muzzle safety device designed to prevent arming within a fifty (50) meter range of the muzzle, but to arm completely after a flight distance of one-hundred-fifty (150) meters.

8. DESCRIPTION OF TEST EQUIPMENT:

a. The two (2) types of fuzes tested were part of fixed ammunition received from the Oerlikon Machine Tool Works. Fuzes and projectiles were assembled as follows:

(1) The KZ nose fuze in a 120 gram SS/K pointed explosive projectile loaded with 13 grams of Pentryl.

(2) The BZ base fuze in a 150 gram PS/B armor piercing explosive projectile loaded with 8.0 grams of Trotyl.

b. Gun:

Oerlikon 20mm 5TG Gun, Mechanism NR 6, with Barrels NR-164 and NR-190, 100.7" length, 1/32.6 calibers twist, mounted on a modified one-pounder stand.

c. Case, Powder:

No information was available on the case or propellant used.

d. Targets:

(1) Blotter paper, Beaverboard (0".190-.58 lbs/ft^2).

(2) Aluminum alloy, 24S-T4 clad in thickness of 0".016.

(3) Aluminum alloy, 24S-T3 or 24S-T4, in thicknesses of 0".020, 0".040, 0".125, and 0".500.

(4) Cold rolled strip steel in thickness of 0".125 in dead soft temper at Rockwell B hardness 45±7.

e. A 160' range with armor plate butt, target mounting jig, and velocity measuring equipment.

f. A 525' open range with target mounting jig and velocity measuring equipment.

9. PROCEDURE:

a. Functioning and Sensitivity Tests:

With the concurrence of the representatives present, the KZ and BZ fuzes as assembled in fixed ammunition were fired from the Oerlikon 5TG gun versus targets listed in paragraph 8(d) set at various obliquities. At fifty (50) feet forward of the muzzle, rounds assembled with KZ nose fuzes gave mean velocities of 3619 to 3731 ft/sec and rounds assembled with BZ base fuzes gave mean velocities of 3254 to 3315 ft/sec. Beaverboard, chipboard, or blotter paper was placed behind the target for most firings to determine fuze action on the target and to determine the approximate distance of delayed fuze action. Blotter paper was placed slightly forward of the target on some rounds to measure yaw. Detailed conditions of test are given in Appendices (B) and (C).

b. Arming Distance Tests:

Arming distance tests were conducted with the KZ nose fuze only. The rounds assembled with KZ nose fuzes were fired with service propellant charges versus 0"125 mild steel placed 50 to 500 feet from the muzzle. Results of the tests are given in detail in Appendix (C).

c. Self Destruction Tests:

With a gun elevation of 4°, rounds assembled with the KZ and BZ fuzes were fired down river to determine the approximate time and range of self-destruction. Time of self-destruction was measured by two (2) stop watches. Range of self-destruction was determined by two (2) down river observation stations. These two (2) stations took bearings on the burst, and a "fix" was obtained from these bearings. The details of test are given in Appendices (B) and (C).

10. RESULTS AND DISCUSSION:

a. Results of all tests are given in detail in Appendices (B) and (C).

b. Functioning and/or Sensitivity tests of the BZ Fuze.

(1) The results obtained using the BZ base fuze assembled in the PS/B armor piercing explosive projectile are summarized in Table I, Appendix (A). One (1) round is not included in Table I because fuze action could not be definitely determined.

(2) With the concurrence of the representatives present, functioning and/or sensitivity tests of the BZ base fuze were not completed because of excessive yaw. This yaw was estimated to be as much as 20° on some rounds. A new barrel was used in an attempt to eliminate the yaw. When the projectiles continued to yaw, the range was increased from 160 to 500 feet. Yaw was evident at 500 feet and the tests were terminated because it was not considered feasible to conduct a fuze functioning test with an unstable projectile. Figure 1, Appendix (D), is a photograph of the yaw cards showing the extent of yaw of the PS/B round.

(3) The Bureau of Ordnance requested additional information on the BZ fuze because a fuze with an inherent delay feature is desired for use with the 20mm Mk 12 gun. In view of the above fact, the Naval Ordnance Laboratory examined some of the PS/B rounds assembled with BZ fuzes and found they were not consistent. X-ray examination showed that some rounds had lead in the projectile cavity. Since this lead varied in amount and shape from one round to another, the Naval Ordnance Laboratory thought this might be the cause of yaw. Sixteen (16) rounds, comprised of eight (8) rounds with lead in the projectile cavity and eight (8) rounds with no lead in the cavity, were shipped to the Naval Proving Ground for testing to determine whether the lead in the cavity was the cause of yaw and also to compare the amount of yaw with fuze action.

(4) The rounds fired on 14 April 1953 that were known to have lead in the projectile cavity exhibited slightly more yaw but a better functioning performance than the rounds that were known to have no lead in the cavity.

(5) As may be noted in Table I, Appendix (A), an overall functioning performance of 65% was obtained with the BZ fuze versus 0".125 mild steel at 0° obliquity with mean velocities of 3254 to 3315 ft/sec. The low performance at these conditions might possibly have been caused by the excessive yaw, and therefore the results obtained are considered inconclusive.

(6) When fired against a target of 0".125 mild steel at 0° obliquity with mean velocities of 3257 to 3315 ft/sec., the BZ base fuze exhibited a slight delay in fuze action of approximately .001 second. Figure 1, Appendix (D), is a photograph showing typical delayed fuze action.

c. Functioning and/or Sensitivity Tests of the KZ Fuze:

(1) Results of all tests of the KZ nose fuze assembled in the pointed SS/K explosive projectile are given in detail in Appendix (C) and are summarized in Table II, Appendix (A).

(2) As noted in Table II, Appendix (A), the KZ nose fuze exhibited a satisfactory (100%) functioning performance at 0° obliquity versus 0".125 24S-T3 aluminum alloy and all heavier targets employed.

(3) The KZ fuze functioned 100% against 0".020 24S-T3 aluminum alloy at 30° obliquity and 0".125 24S-T3 aluminum alloy at 80° obliquity.

(4) The KZ fuze gave a functioning performance of 80% or greater versus 0".020 24S-T3 aluminum alloy at obliquities of 0° to 70°, 0".125 24S-T3 aluminum alloy at obliquities of 0° to 80°, and versus 0".190 Beaverboard, 0".040 24S-T3 aluminum alloy, and 0".016 24S-T3 clad aluminum alloy at 0° obliquity.

(5) The KZ fuze was sensitive enough to function 40% on 0".020 blotter paper at 0° obliquity.

(6) When fired against thin targets of 0".016 to 0".040 24S-T3 aluminum alloy at 0° obliquity with mean velocities of 3619 to 3731 ft/sec., the KZ nose fuze exhibited a slight delay in fuze action of approximately .00015 second.

d. Arming Distance Test:

The results of the arming distance tests of the KZ fuze are given in detail in Appendix (C) and summarized in Table III, Appendix (A). The KZ nose fuze was not armed at 50 feet from the muzzle, was at times armed at 100 to 450 feet from muzzle, and was armed 100% of the time at a distance of 500 feet from the muzzle when fired with a mean velocity of 3619 to 3717 ft/sec against a 0".125 mild steel target.

e. Self-destruction of the KZ and BZ Fuzes:

(1) Twenty-five (25) rounds each of types KZ and BZ fuzes were fired to determine self-destruction time and range. The results are given in detail in Appendices (B) and (C).

(2) The self-destruction mechanism operated on twenty-three (23) or 92% of the BZ fuzes at an average range of 2287.4 yards and an average flight time of 4.60 seconds.

(3) The self-destruction mechanism operated on twenty-two (22) or 88% of the KZ fuzes at an average range of 2842.3 yards and an average flight time of 5.47 seconds.

PART D

CONCLUSIONS

11. It is concluded from the results obtained that:

a. The KZ and BZ fuzes gave no bore or flight premature detonations when fired as single rounds from the Oerlikon 5TG gun.

b. The BZ base fuze assembled in the PS/B armor piercing explosive projectile when fired with mean velocities of 3254 to 3315 ft/sec:

(1) Was unstable in flight and fuze functioning was not determinable.

(2) Gave a slightly better functioning performance but yawed slightly more with projectiles known to have lead in the cavity. (Based upon limited comparative firings of projectiles with and without lead in the cavity.)

(3) Exhibited a 92% self-destruction performance at an average range of 2287.4 yards from the muzzle with an average flight time of 4.60 seconds.

(4) Detonated with delayed fuze action of approximately .001 second when fired against a 0".125 mild steel target.

c. The KZ nose fuze assembled in the SS/K explosive projectile when fired with mean velocities of 3619 to 3731 ft/sec:

(1) Functioned 100% versus 0".125 24S-T3 aluminum alloy and all heavier targets employed at 0° obliquity.

(2) Functioned 100% against 0".020 24S-T3 aluminum alloy at 30° obliquity and against 0".125 24S-T3 aluminum alloy at 80° obliquity.

(3) Gave a functioning performance of 80% or greater against: 0".020 24S-T3 aluminum alloy at obliquities of 0° to 70°, 0".125 24S-T3 aluminum alloy at obliquities of 0° to 80°, versus 0".190 Beaverboard, 0".040 24S-T3 aluminum alloy, and 0".016 24S-T3 clad aluminum alloy at 0° obliquity.

(4) Was sensitive enough to function 40% on 0".020 blotter paper at 0° obliquity.

(5) Was not armed at 50 feet from the muzzle, but was fully armed at a distance of 500 feet from the muzzle when fired against a target of 0".125 mild steel.

(6) Exhibited an 88% self-destruction performance at an average range of 2842.3 yards with an average flight time of 5.47 seconds.

(7) Detonated with delayed fuze action of approximately .00015 second when fired against thin targets of 0".016 to 0".040 24S-T3 aluminum alloy at 0° obliquity.

Tests of Oerlikon BZ and KZ Fuzes for 20mm Ammunition

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NPG REPORT NO. 1142

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Twenty-second Partial Report

on

Research, Development and Tests of

High Performance Aircraft Machine Gun Fuzes

- -

Final Report

on

Tests of Oerlikon BZ and KZ Fuzes for 20mm Ammunition

Project No: NPG-Re2b-327-1-53
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EXPLANATION OF SYMBOLS USED

BW	-	Back Wall (5'2" Behind Target)
HO	-	High Order Detonation
NFA	-	No Fuse Action
AV	-	Average
AA	-	Aluminum alloy
Rds.	-	Rounds
Ft/sec	-	Feet per second
OBL	-	Obliquity
Yaw card	-	0".020 Blotter paper

Chipboard Thickness - 0".140

Beaverboard Thickness - 0".190

TABLE I

SUMMARY OF FUNCTIONING AND/OR SENSITIVITY TESTS OF OERLIKON BZ FUZE

Date Fired	Target	Mean Velocity ft/sec	Obliquity	Fuse Action		
				Rds. Fired	Rds. HO	% HO
Sep 19-26, 1952	0".125 Mild Steel	3257-3315	0°	15	10	67
*April 14, 1953	0".125 Mild Steel	3254-3293	0°	8	6	75
**April 14, 1953	0".125 Mild Steel	3257-3308	0°	8	4	50
Overall	0".125 Mild Steel	3254-3315	0°	31	20	65

*X-ray examination showed these rounds had lead in the projectile cavity.

**X-ray examination showed these rounds had no lead in the projectile cavity.

TABLE II

SUMMARY OF FUNCTIONING AND/OR SENSITIVITY TEST RESULTS OF OERLIKON KZ FUZE

Target	0°		30°		60°		70°		80°	
	Rds. Fired	% HO	Rds. Fired	% HO	Rds. Fired	% HO	Rds. Fired	% HO	Rds. Fired	% HO
0".020 Blotter Paper	10	40								
0".016 24S-T3 Al. Alloy (Clad)	20	85								
0".020 24S-T3 Al. Alloy	20	80	10	100	10	90	10	90		
0".190 Beaverboard	20	85								
0".040 24S-T3 Al. Alloy	20	85								
0".125 24S-T3 Al. Alloy	10	100	10	80	10	90	10	80	10	100
0".125 Mild Steel	13	100								
0".500 24S-T4 Al. Alloy	5	100								

All rounds were fired with mean velocities of 3619 to 3731 feet per second which were measured 50 feet forward of muzzle.

TABLE III

SUMMARY OF KZ FUZE ARMING TEST RESULTS

*Target Distance	Rounds Fired	Rounds HO	% HO
50 feet	10	0	0
100 feet	10	2	20
150 feet	10	4	40
200 feet	10	7	70
250 feet	10	6	60
300 feet	10	7	70
400 feet	10	9	90
450 feet	10	6	60
500 feet	13	13	100

*Target used for all arming distance tests was 0".125 Mild Steel.
All rounds were fired with mean velocities of 3619 to 3717 ft/sec.

BZ FUZE FIRING RECORD

FUNCTIONING TEST

Gun: 5TG, Mechanism NR6, Barrel NR190(Rds. 1-10), Barrel NR164(Rds. 11-16)
Range: 2; 160 ft.- Rds. 1-13. Aircraft Test Range 525 ft., Rds. 14-16
Fuze: BZ (Base); PS/B Round
Projectile: Oerlikon PS/B; APHE
Remarks: Mean velocity measured 50 feet forward of muzzle

Date: 19 September 1952
Mfr: Oerlikon Machine Tool Works, Buehrle and Company. Zurich - Oerlikon, Switzerland.

Rd. No.	Mean Velocity	Obl.	Target	Fuze Action	Remarks
1	3257	0°	0".125 Mild Steel; 0".125 Mild Steel 2 Ft. Aft, Beaverboard at sides, Yaw Card 1 Foot Forward	Not Noted	5-10° Yaw
2	3297	"	0".125 Mild Steel; Beaverboard at sides, Yaw Card 1 Foot Forward	HO	Approximately 4' Delay, 5-10° Yaw
3	3304	"	0".125 Mild Steel; Beaverboard at sides, Yaw Card 1 Foot Forward Beaverboard 69 inches Aft.	HO	Approximately 4' Delay, 5° Yaw
4	3272	"	0".125 Mild Steel; Yaw Cards 1 Foot Forward and 4 Foet Aft, Beaverboard at 5'2" Aft.	HO	3-4 ft. Delay, No Yaw
5	3297	"	0".125 Mild Steel; Yaw Cards 1 Foot Forward and 42" Aft, Beaverboard 5'2" Aft.	HO	3-3 1/2 ft., No Yaw
6	3272	"	0".125 Mild Steel; Yaw Cards 1 Foot Forward and 3' Aft, Beaverboard 5'2" Aft.	NFA	15-20° Yaw
7	3282	"	"	HO	3 ft. Delay, Yaw(?) Hit Frame
8	3282	"	"	NFA	15-20° Yaw, Deflagrated or HO on BP

BZ FUZE FIRING RECORD (Continued) Date: 19 September 1952

Rd. No.	Mean Velocity	Obl.	Target	Fuze Action	Remarks
9	3289	0°	0".125 Mild Steel; Yaw Cards 1 Foot Forward and 3' Aft, Beaverboard 5'2" Aft.	NFA	5-10° Yaw, Deflagrated or HO on BW
10	3315	"	"	HO	2-3 ft. delay, No Yaw
			New Barrel NR164		
11	3315	0°	0".125 Mild Steel; Yaw Card 1 Foot Forward, 3 ft. Aft, Beaverboard 5'2" Aft.	HO	2-3 ft. delay, No Yaw
12	3300	"	"	HO	3 ft. delay, No Yaw
13	3289	"	"	NFA	20° Yaw
			26 September 1952; Aircraft Test Range - Target at 500 feet		
14	Miss	0°	0".125 Mild Steel; Yaw Card 1 Foot Forward, Beaverboard 4-1/2 Ft. Aft.	HO	Beyond 4-1/2 Ft; 5-10° Yaw
15	3297	"	0".125 Mild Steel; Yaw Card 2 Feet Forward, Beaverboard 8 Ft. Aft.	HO	0-8° Delay; No Yaw
16	3286	"	0".125 Mild Steel; Yaw Card 2 Feet Forward, Beaverboard 8 Ft. Aft.	NFA	5-10° Yaw

BZ FUZE FIRING RECORD (Continued)

Gun: Oerlikon 20mm STG, NR6 Mechanism, NR164 Barrel
Range: 2; 160 Ft.
Fuze: BZ
Projectile: PS/B Round
Remarks: Even numbered rounds have lead in Projectile Cavity
Odd numbered rounds have no lead in Projectile Cavity
Yaw Card 3 Ft. Forward of Target on all rounds

Date: 14 April 1953
Mfr: Oerlikon Machine Tool Works, Zurich - Oerlikon, Switzerland.

Rd. No.	Fuze No.	Mean Velocity	Obl.	Target	Fuze Action	Remarks
17	1	3297	0°	0".125 Mild Steel; Yaw Card 2 & 4 ft. aft; Beaverboard at sides and Back Wall	NFA	No Yaw, 3/4" Hole
18	4	3282	"	"	HO	5° - 8° Yaw; 2-4 Ft. delay
19	2	3257	"	0".125 Mild Steel; Yaw Cards 2 and 4 ft. aft; Beaverboard at Back Wall	HO	No Yaw; 2-4 Ft. delay
20	7	3279	"	0".125 Mild Steel; Yaw Cards 2 and 3 ft. aft; Beaverboard at Back Wall	NFA	20-25° Yaw
21	3	Miss	"	"	HO	No Yaw; 2 Ft. delay
22	18	3257	"	"	HO	No Yaw; 2 Ft. delay
23	5	3268	"	"	HO	No Yaw; 2 Ft. delay
24	22	3282	"	"	NFA	10-15° Yaw
25	6	3304	"	"	NFA	No Yaw
26	25	3254	"	"	HO	No Yaw; 3 Ft. delay
27	8	3308	"	"	NFA	5-8° Yaw
28	36	3257	"	"	HO	No Yaw; 2-1/2 - 3 Ft. delay
29	9	3279	"	"	HO	No Yaw; 2 Ft. delay
30	40	3293	"	"	HO	3-5° Yaw; 0-2 Ft. delay
31	10	3268	"	"	NFA	10-15° Yaw
32	43	3282	"	"	HO	No Yaw; 0-2 Ft. delay

BZ FUZE FIRING RECORD (Continued)

OERLIKON SELF-DESTRUCTION TESTS

Gun: Oerlikon 5TG, Barrel NR190 Date: 7 January 1953
Fuze: BZ; Round PS/B
Line of Fire: 126°40'
Gun Elevation: 4°

Round Number	Time 1st Watch	Time 2nd Watch	Range	Fuze Action
1	5.55	5.57	2552	HO
2	4.70	4.68	2333	HO
3	5.25	5.30	2479	HO
4	4.65	4.64	2333	HO
5	--	--	--	NFA
6	4.00	4.07	2137	HO
7	4.75	4.90	2392	HO
8	3.80	3.81	2042	HO
9	5.20	5.34	2469	HO
10	10.24	Miss	3016	HO
11	4.11	4.10	2111	HO
12	3.81	4.08	2072	HO
13	--	--	--	NFA
14	4.06	4.06	2289	HO
15	5.42	5.42	2507	HO
16	4.55	4.66	2287	HO
17	4.10	4.09	2131	HO
18	3.61	3.60	1978	HO
19	3.95	4.04	2105	HO
20	4.65	4.80	2366	HO
21	3.85	3.85	2075	HO
22	3.71	3.72	2024	HO
23	5.25	5.57	2496	HO
24	4.60	4.53	2283	HO
25	4.00	4.07	2133	HO
Average	4.69	4.50	2287.4	

KZ FUZE FIRING RECORD

ARMING DISTANCE TESTS

Gun: 20mm, 5TG, Barrel NR164
Range: Aircraft Test
Projectile: SS/K; HE
Fuze: KZ, Nose
Remarks: Mean Velocity measured 50 feet forward of Muzzle

Date: 27 September 1952
Mfr.: Oerlikon Machine Tool Works, Buehrle and Company, Zurich - Oerlikon, Switzerland

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
1	3681	0°	0".125 Mild Steel at 500 ft. Beaverboard 8 Ft. Aft Yaw Card 2 Ft. Forward	HO Slight Delay and Yaw
2	3676	"	"	HO Slight Delay and Yaw
3	3695	"	"	HO On Yaw Card, No delay
4	3663	"	"	HO Slight Yaw
5	3667	"	0".125 Mild Steel at 500 ft. Beaverboard 5 Ft. Aft.	HO Slight Delay, 2-1/2" Hole
6	3650	"	"	HO Slight Delay, 2-1/2" Hole
7	3628	"	"	Missed Target, HO on Beaverboard
8	3655	"	"	Missed Target, HO on Beaverboard
9	3660	"	"	HO Slight Delay, 3-1/2" Hole
10	3667	"	"	HO Slight Delay, 3" Hole
11	3667	"	"	HO 3" Hole
12	3628	"	"	HO 3" Hole
13	3641	"	"	HO 3" Hole
14	3662	"	"	HO 3" Hole
15	3676	"	"	HO Slight Delay, 2-1/2" Hole
16	3676	"	"	HO 3" Hole
17	3667	"	0".125 Mild Steel at 200 ft. Beaverboard 5 Ft. Aft.	HO 3" Hole
18	3628	"	"	HO 3" Hole
19	3672	"	"	NFA 3/4" Hole
20	3663	"	"	HO 3" Hole
21	3663	"	"	NFA 3/4" Hole

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Arming Distance Tests (Continued)) Date: 27 September 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
22	3699	0°	0.125 Mild Steel at 200 ft. Beaverboard 5 Ft. Aft.	HO 3" Hole
23	3619	"	"	HO 3" Hole
24	3704	"	"	HO Delay
25	3655	"	"	HO 3" Hole
26	3667	"	"	NFA On Target - HO on Beaverboard
27	3649	0°	0.125 Mild Steel at 150 ft. Blotter paper 5 Ft. Aft.	HO 3" Hole
28	Miss	"	"	NFA 3/4" Hole
29	Miss	"	"	NFA 3/4" Hole
30	Miss	"	"	NFA 3/4" Hole
31	Miss	"	"	NFA 3/4" Hole
32	Miss	"	"	NFA 3/4" Hole
33	Miss	"	"	NFA 3/4" Hole
34	Miss	"	"	HO 3" Hole
35	3695	"	"	HO 3" Hole
36	3690	"	"	HO 3" Hole
37	3660	0°	0.125 Mild Steel at 100 ft. Blotter paper 5 Ft. Aft.	NFA 3/4" Hole
38	3660	"	"	NFA 3/4" Hole
39	3686	"	"	NFA 3/4" Hole
40	3660	"	"	HO 3" Hole
41	3672	"	"	NFA 3/4" Hole
42	3632	"	"	NFA 3/4" Hole
43	3667	"	"	NFA 3/4" Hole
44	3655	"	"	HO 3" Hole
45	3663	"	"	NFA 3/4" Hole
46	3663	"	"	NFA 3/4" Hole

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Arming Distance Tests (Continued)) Date: 27 September 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
47	Not Measured	0°	0".125 Mild Steel at 50 feet	NFA 3/4" Hole
48	" "	"	"	NFA 3/4" Hole
49	" "	"	"	NFA 3/4" Hole
50	" "	"	"	NFA 3/4" Hole
51	" "	"	"	NFA 3/4" Hole
52	" "	"	"	NFA 3/4" Hole
53	" "	"	"	NFA 3/4" Hole
54	" "	"	"	NFA 3/4" Hole
55	" "	"	"	NFA 3/4" Hole
56	" "	"	"	NFA 3/4" Hole
57	3686	0°	0".125 Mild Steel at 250 feet Blotter paper 5 Ft. Aft.	NFA 3/4" Hole
58	3672	"	"	HO 3" Hole
59	3676	"	"	HO 3" Hole
60	3699	"	"	HO 3" Hole
61	3676	"	"	HO 3" Hole
62	3695	"	"	NFA 3/4" Hole
63	3690	"	"	HO 3" Hole
64	3686	"	"	NFA 3/4" Hole
65	3681	"	"	NFA 3/4" Hole
66	3717	"	"	HO Slight Delay
67	3699	0°	0".125 Mild Steel at 300 feet Blotter paper 5 Ft. Aft.	HO 3" Hole
68	3722	"	"	NFA 3/4" Hole
69	3667	"	"	HO 3" Hole
70	3708	"	"	NFA 3/4" Hole
71	3690	"	"	NFA 3/4" Hole
72	3676	"	"	HO 3" Hole
73	3690	"	"	HO 3" Hole
74	3663	"	"	HO 3" Hole
75	3649	"	"	HO 3" Hole
76	3690	"	"	HO 3" Hole

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Arming Distance Tests (Continued)) Date: 24 November 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
77	Not Measured	0°	0".125 Mild Steel at 400 feet Chipboard 5 Ft. Aft.	HO 2 x 3-1/2" Hole
78	" "	"	"	HO 2 x 3" Hole
79	" "	"	"	HO 2 x 2" Hole
80	" "	"	"	HO 2 x 3" Hole
81	" "	"	"	HO 2 x 1-1/2" Hole
82	" "	"	"	HO 2 x 2" Hole
83	" "	"	"	HO 2 x 2" Hole
84	" "	"	"	HO 2 x 3" Hole
85	" "	"	"	HO 2 x 2-1/2" Hole
86	" "	"	"	NFA 3/4" Hole
87	" "	0°	0".125 Mild Steel at 450 feet Chipboard 5 Ft. behind	NFA 3/4" Hole
88	" "	"	"	HO 3 x 2" Hole
89	" "	"	"	NFA HO on Chipboard
90	" "	"	"	NFA 3/4" Hole
91	" "	"	"	HO 2 x 3" Hole
92	" "	"	"	HO 3" Hole
93	" "	"	"	HO 2" Hole
94	" "	"	"	HO 1-1/2" Hole Slight Delay
95	" "	"	"	HO Slight Delay
96	" "	"	"	NFA HO on Chipboard

KZ FUZE FIRING RECORD (Continued)

FUNCTIONING TEST

Gun: 20mm STG, Barrel NR164 Date: 24 November 1952
Range: Aircraft Test, 525 Ft.
Projectile: SS/K; HE
Fuze: KZ, Nose
Remarks: Mean Velocity Measured 50 Ft. Forward of Muzzle
Rds. 97 to 121 - Targets 500 feet from muzzle

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
97	3704	0°	0".040 AA; Chipboard 5 Ft. Aft.	HO Delayed Fuze Action
98	3681	"	"	HO Delayed Fuze Action
99	3686	"	"	HO Delayed Fuze Action
100	3660	"	"	HO Delayed Fuze Action
101	3708	"	"	HO Delayed Fuze Action
102	3655	"	"	HO Delayed Fuze Action
103	3686	"	"	HO Delayed Fuze Action
104	3655	"	"	HO Delayed Fuze Action
105	3699	"	"	HO Delayed Fuze Action
106	3708	"	"	HO Delayed Fuze Action
107	Miss	0°	0".020 AA; Beaverboard 5 Ft. Aft. Blotter paper 2 Ft. Aft.	HO 0" to 24" Delay
108	Miss	"	0".020 AA; Beaverboard 5 Ft. Aft. Blotter paper 1 Ft. Aft.	HO 0" to 12" Delay
109	3649	"	0".020 AA; Beaverboard 5 Ft. Aft. Blotter paper 8 inches Aft.	HO 0" to 8" Delay
110	3667	"	0".020 AA; Beaverboard 5 Ft. Aft.	NFA 3/4" Hole
111	3672	"	"	NFA HO on Water
112	3699	0°	0".020 AA; Chipboard 20 inches Aft.	NFA 3/4" Hole

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Functioning Test (Continued)) Date: 24 November 1952,
Remarks: Rds. 121 to 237 - Targets 525 ft. foward of muzzle. 3 December 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
113	3708	0°	0"020 AA; Chipboard 2.5 Ft. behind	HO Slight Delay
114	3727	"	"	HO Slight Delay
115	3681	"	"	HO Slight Delay
116	3681	"	"	HO Slight Delay
117	3663	0°	0"190 Beaverboard, Chipboard 2.5 Ft. behind	HO Slight Delay
118	3686	"	"	HO Slight Delay
119	3681	"	"	-- Disregard - Hit Frame
120	3704	"	"	HO Slight Delay
121	3699	"	"	-- Disregard - Hit Frame
			3 December 1952 525 Ft.	
122	3632	0°	0"190 Beaverboard, Chipboard 3 Ft. behind	NFA 3/4" Hole
123	3690	"	"	HO Slight Delay
124	3717	"	"	HO Slight Delay
125	3672	"	"	Disregard - Hit Frame
126	3667	"	"	HO Slight Delay
127	3660	"	"	HO Slight Delay
128	3699	"	"	HO Slight Delay
129	3695	"	"	NFA 3/4" Hole
130	3690	0°	0"C16 Alclad - Chipboard 3 Ft. behind	NFA 3/4" Hole
131	3676	"	"	HO 0-3' Delay
132	3686	"	"	HO 0-3' Delay
133	3727	"	"	HO 0-3' Delay
134	3686	"	"	HO 0-3' Delay
135	3681	"	"	NFA 3/4" Hole

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Functioning Test (Continued)) Date: 3 December 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
136	3699	0°	0".016 Alclad - Chipboard 3 Ft. behind	HO 0-3' Delay
137	3663	"	"	HO 0-3' Delay
138	3690	"	"	HO 0-3' Delay
139	3681	"	"	Disregard - Went thru old Hole
140	3690	"	"	HO 0-3' Dolay
141	3672	0°	0".125 AA - Chipboard 3 Ft. behind	HO 2" Hole
142	3690	"	"	HO 1-1/2" Hole
143	3704	"	"	HO 1-1/2" Hole
144	3690	"	"	HO 1-1/2" Hole
145	3676	"	"	HO 1-1/2" Hole
146	3704	"	"	HO 1" Hole
147	3695	"	"	HO 1-1/2" Hole
148	3690	"	"	HO 1-1/2" Hole
149	3690	"	"	HO 1-1/2" Hole
150	3704	"	"	HO 1-1/2" Hole
151	3699	0°	0".500 - 24S-T4 AA	HO 2-1/2" Hole
152	3727	"	"	HO 2-1/2" Hole
153	3655	"	"	HO 2-1/2" Hole
154	3699	"	"	HO 2-1/2" Hole
155	3681	"	"	HO 2-1/2" Hole
156	3681	30°	0".125 - 24S-T3 AA	HO Slight Delay
157	3667	"	"	HO Slight Delay
158	3681	"	"	Disregard - Hit Frame
159	3681	"	"	HO 2" Hole
160	3699	"	"	HO 1-3/4" Hole
161	3667	"	"	NFA 1" Hole
162	3686	"	"	NFA 1" Hole
163	3699	"	"	HO Slight Delay

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Functioning Test (Continued)) Date: 3 December 1952, 11 December 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
164	3704	30°	0".125 24S-T3 AA - Chipboard 3 Ft. behind	HO Slight Delay
165	3704	"	"	HO Slight Delay
166	3681	"	"	Disregard - Went thru old Hole
167	3731	"	"	HO Slight Delay
168	3704	30°	C".020 24S-T3 AA - Chipboard 3 Ft. behind	HO Slight Delay
169	3699	"	"	HO Slight Delay
170	3681	"	"	HO Slight Delay
			11 December 1952	
171	Miss	30°	0".020 24S-T3 AA - Chipboard 3 Ft. behind	Disregard - Hit Frame
172	3660	"	"	HO Slight Delay
173	3672	"	"	HO Slight Delay
174	3681	"	"	HO Slight Delay
175	Miss	"	"	HO Slight Delay
176	Miss	"	"	HO Slight Delay
177	Miss	"	"	HO Slight Delay
178	Miss	"	"	HO Slight Delay
179	Miss	60°	0".125 24S-T3 AA	HO 2" x 3" Hole
180	3704	"	"	HO 2" x 3" Hole
181	3690	"	"	HO 2" x 3" Hole
182	3690	"	"	HO 2" x 3" Hole
183	3676	"	"	HO 2" x 3" Hole
184	3704	"	"	HO 2" x 2" Hole
185	Miss	"	"	NFA 1" x 2" Hole
186	Miss	"	"	HO 2" x 3" Hole
187	Miss	"	"	HO 2" x 3" Hole
188	Miss	"	"	HO 2-1/2" x 3-1/2" Hole

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Functioning Test (Continued)) Date: 18 December 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
189	Velocity	60°	0".020 24S-T3 AA	HO 8" x 9" Hole
190	Not Measured	"	"	HO 9" x 11" Hole
191	" "	"	"	HO 8" x 10" Hole
192	" "	"	"	Disregard - Went thru old Hole
193	" "	"	"	HO 11" x 12" Hole
194	" "	"	"	HO 8" x 11" Hole
195	" "	"	"	Disregard - Went thru previous Hole
196	" "	"	"	HO 9" x 13" Hole
197	" "	"	"	NFA 1-1/4" Hole HO on Water
198	" "	"	"	HO 8" x 9" Hole
199	" "	"	"	HO 10" x 11" Hole
200	" "	"	"	HO 6" x 10" Hole
201	" "	70°	0".020 24S-T3 AA	HO 6" x 7" Hole
202	" "	"	"	HO 5" x 8" Hole
203	" "	"	"	HO 6" x 9" Hole
204	" "	"	"	NFA 1-1/2" Hole
205	" "	"	"	HO 6" x 6" Hole
206	" "	"	"	HO 6" x 6" Hole
207	" "	"	"	HO 6" x 7" Hole
208	" "	"	"	HO 7" x 7" Hole
209	" "	"	"	HO 4" x 8" Hole
210	" "	"	"	HO 6" x 7" Hole
211	" "	70°	0".125 24S-T3 AA	HO 3" x 3" Hole
212	" "	"	"	HO 3" x 3" Hole
213	" "	"	"	NFA 1" x 2" Hole
214	" "	"	"	HO 3" x 3" Hole
215	" "	"	"	HO 3" x 3" Hole
216	" "	"	"	HO 3" x 3" Hole

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose (Functioning Test (Continued)) Date: 18 December 1952

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
217	Velocity	7C°	0".125 24S-T3 AA	HO 3" x 3" Hole
218	Not Measured	"	"	HO 3" x 3" Hole
219	" "	"	"	HO 3" x 3" Hole
220	" "	"	"	NFA 1" x 1-3/4" Hole
221	" "	8C°	0".125 24S-T3 AA	HO 3" Hole
222	" "	"	"	HO 3" Hole
223	" "	"	"	HO 3-1/4" Hole
224	" "	"	"	HO 3-1/4" Hole
225	" "	"	"	HO 3" Hole
226	" "	"	"	HO 4" Hole
227	" "	"	"	HO 3-1/2" Hole
228	" "	"	"	HO 2" x 3" Hole
229	" "	"	"	HO 3" Hole
230	" "	"	"	HO 3-1/2" Hole

KZ FUZE FIRING RECORD (Continued)

Gun: 5TG, Barrel NR164 Date: 19 December 1952
Range: 525 Ft. Aircraft Test Range
Fuze: KZ
Projectile: Round SS/K
Remarks:

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
231	Velocity Not Measured	0°	0".020 Blotter paper, Blotter paper 2' x 4' behind	NFA HO on 2nd sheet
232	" "	"	0".020 Blotter paper, Blotter paper 2' x 4' behind	HO Slight Delay
233	" "	"	0".020 Blotter paper, Blotter paper 2 feet behind	Disregard - Hit Frame
234	" "	"	0".020 Blotter paper, Blotter paper 2 feet behind	NFA on Water
235	" "	"	"	HO Slight Delay
236	" "	"	"	HO Slight Delay
237	" "	"	"	NFA 3/4" Hole

KZ FUZE FIRING RECORD (Continued)

Gun: Oerlikon 5TG, Mechanism NR6, Barrel NR164
Range: Aircraft Test; 525 Ft.
Fuze: KZ, Nose
Projectile: SS/K Round
Remarks:

Date: 9 May 1953
Mfr: Oerlikon

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
238	Not Meausred	0°	0"020 24S-T3 AA; Blotter paper 6, 9, 12, 15 inches Aft of target	HO 6" to 9" delay
239	" "	"	C"020 24S-T3 AA; Blotter paper 6, 9, 12, 15 inches Aft of target	HO 6" delay
240	" "	"	C"C20 24S-T3 AA; Blotter paper 6, 9, 12 inches Aft of target	HO 6" delay
241	" "	"	"	HO C" - 6" delay
242	" "	"	"	HO 6" delay
243	" "	"	"	NFA 3/4" Hole
244	" "	"	0"020 24S-T3 AA; Blotter paper 6, 9, inches Aft of target	HO 6" delay
245	" "	"	"	HO 6" delay
246	" "	"	"	HO 6" delay
247	" "	"	"	HO 6" delay
248	" "	"	0"016 24S-T3 AA; Blotter paper 6, 9, 12, 15 inches Aft of target	HO 9" delay
249	" "	"	"	HO 9" delay
250	" "	"	C"016 24S-T3 AA; Blotter paper 9, 12, 15, inches Aft of target	NFA 3/4" Hole
251	" "	"	0"016 24S-T3 AA; Blotter paper 9, 12, inches Aft of target	HO 9" delay
252	" "	"	"	HO 9" delay
253	" "	"	"	HO 9" delay
254	" "	"	"	HO 9" delay
255	" "	"	"	HO 9" delay
256	" "	"	"	HO 9" delay
257	" "	"	"	HO 9" delay

KZ FUZE FIRING RECORD (Continued)

Fuze: KZ, Nose

Date: 9 May 1953,
11 May 1953

Round No.	Mean Velocity	Obl.	Target	Fuze Action and Remarks
258	Not Measured	0°	0.040 24S-T3 AA; Blotter paper 5, 8 inches Aft of Target	Not Noted - Disregard
259	" "	"	"	HO 5" delay
			11 May 1953	
260	" "	"	0.040 24S-T3 AA; Blotter paper 5, 8 inches Aft of Target	HO 5" delay
261	" "	"	"	HO 5" delay
262	" "	"	0.040 24S-T3 AA; Blotter paper 6, 9 inches Aft of Target	NFA 3/4" Hole
263	" "	"	"	HO 6" delay
264	" "	"	"	NFA 3/4" Hole
265	" "	"	"	HO 6" delay
266	" "	"	0.040 24S-T3 AA; Blotter paper 12 inches Aft of Target	NFA HO on Water
267	" "	"	"	HO 0-12" delay
268	" "	"	0.040 24S-T3 AA; Blotter paper 5, 8 inches Aft. of Target	HO 5" delay
269	" "	0°	0.190 Beaverboard; Blotter paper 5, 8, 15 inches Aft of Target	HO 5" delay
270	" "	"	"	HO 5" delay
271	" "	"	0.190 Beaverboard; Blotter paper 5, 8 inches Aft of Target	HO 5" delay
272	" "	"	"	HO 5" delay
273	" "	"	0.190 Beaverboard; Blotter paper 3, 5 inches Aft of Target	HO 3" delay
274	" "	"	"	NFA 3/4" delay
275	" "	"	"	HO Greater than 5" delay
276	" "	"	"	HO 3" delay
277	" "	"	"	HO 5" delay
278	" "	"	"	HO 3" delay

KZ FUZES FIRING RECORD (Continued)

OERLIKON SELF-DESTRUCTION TEST

Gun: Oerlikon 5TG, Barrel NR190
Fuze: KZ fuze, Round SSK
Line of Fire: 126°40'
Gun Elevation: 8° for rds. 1-2, 4° for rds 3-25.

Date: 7 January 1953

Round No.	Time 1st Watch	Time 2nd Watch	Range	Fuze Action
1	Miss	Miss	2669	HO
2	5.93	6.0	2928	HO
3	5.92	Miss	2961	HO
4	5.30	Miss	2806	HO
5	6.2	6.2	3088	HO
6	5.25	5.3	2806	HO
7	5.65	5.7	2897	HO
8	5.90	5.77	2955	HO
9	--	--	--	NFA
10	--	--	--	NFA
11	5.56	5.5	2801	HO
12	5.3	5.54	2834	HO
13	5.8	5.8	2963	HO
14	4.90	4.89	2674	HO
15	4.68	4.81	2628	HO
16	--	--	3831	NFA HO on Water
17	6.0	6.0	2823	HO
18	4.92	4.90	2686	HO
19	5.68	5.70	2981	HO
20	5.2	5.07	2801	HO
21	5.18	5.00	2759	HO
22	5.65	5.57	2913	HO
23	5.44	5.50	2920	HO
24	5.45	5.22	2901	HO
25	5.1	5.04	2736	HO
Average	5.48	5.46	2842.3	

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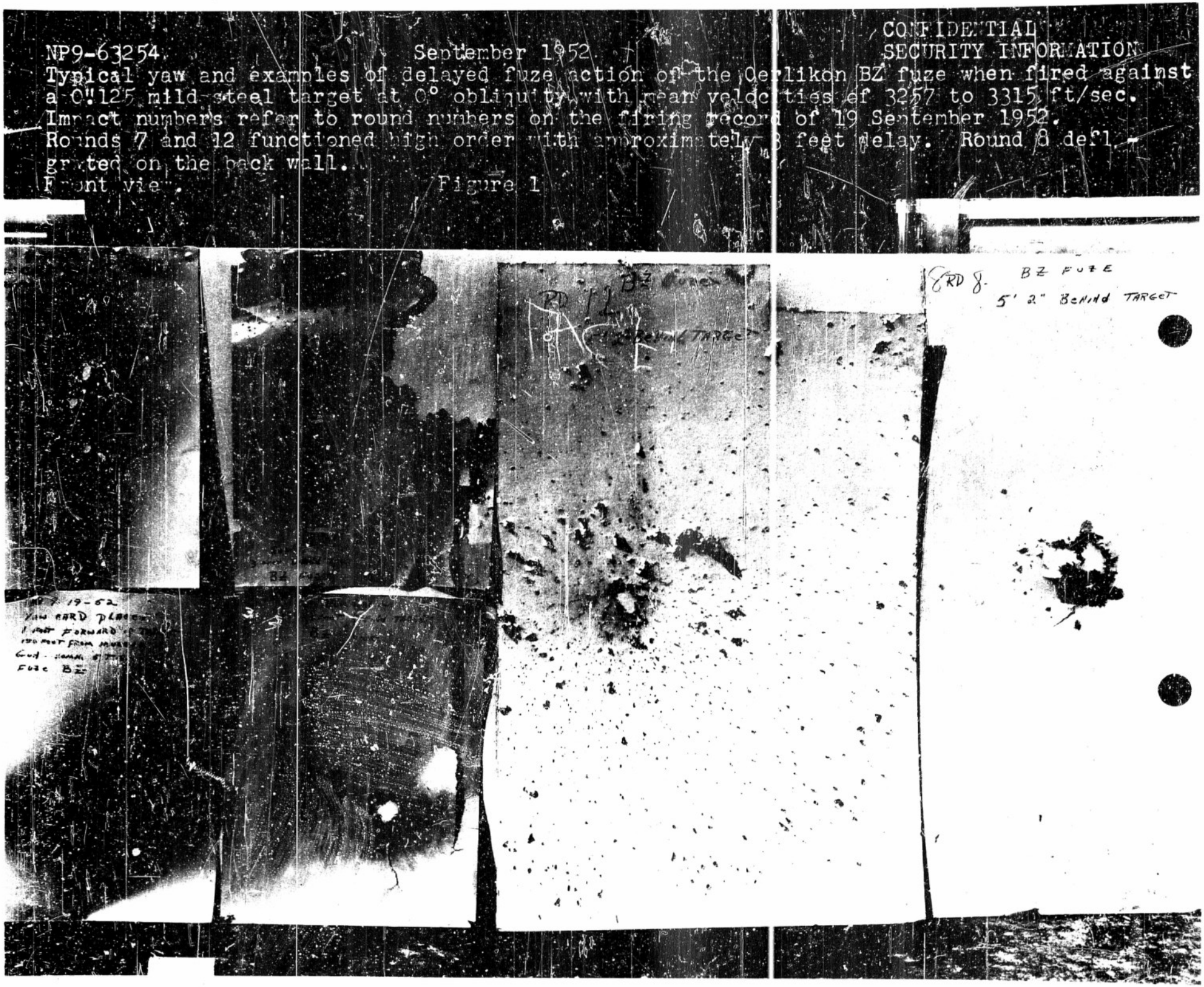
SECURITY INFORMATION

Typical yaw and examples of delayed fuze action of the Oerlikon BZ fuze when fired against a 0.125 mild steel target at 0° obliquity with mean velocities of 3257 to 3315 ft/sec. Impact numbers refer to round numbers on the firing record of 19 September 1952. Rounds 7 and 12 functioned high order with approximately 3 feet delay. Round 8 deflagrated on the back wall.
Front view.

Figure 1



Tests of Cerlikon BZ and KZ Fuzes for 20mm Ammunition

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